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LoBello

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(54) **UNDERGROUND STORMWATER MANAGEMENT SYSTEM AND METHOD**

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(21) Appl. No.: **12/512,271**

(22) Filed: **Jul. 30, 2009**

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(51) **Int. Cl.**
E03F 5/14 (2006.01)

(52) **U.S. Cl.** **210/747.2**; 210/800; 210/804; 210/170.03; 210/254; 210/257.1; 210/299; 210/532.1; 405/40; 405/51; 405/52

(58) **Field of Classification Search** 210/170.03, 210/254, 257.1, 299, 532.1, 747, 800, 804; 405/36, 40, 41, 51, 52
See application file for complete search history.

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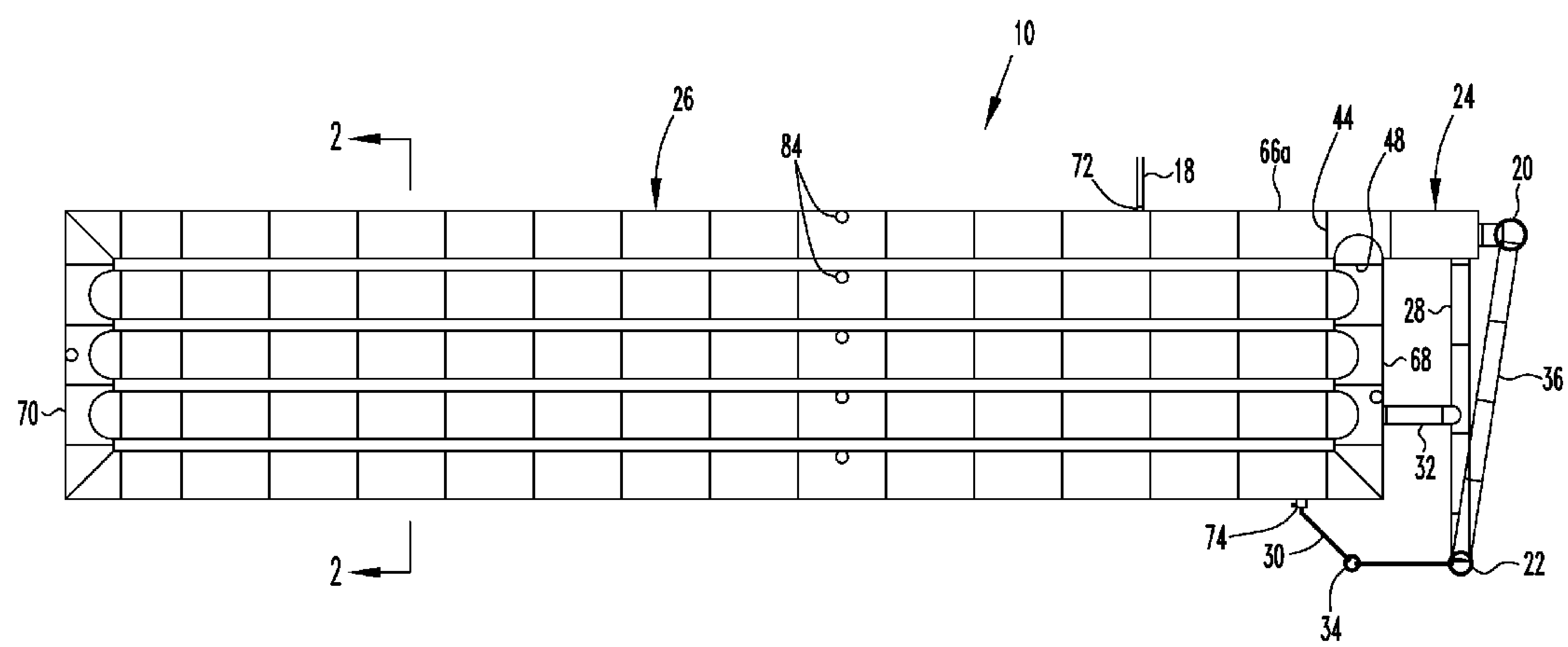
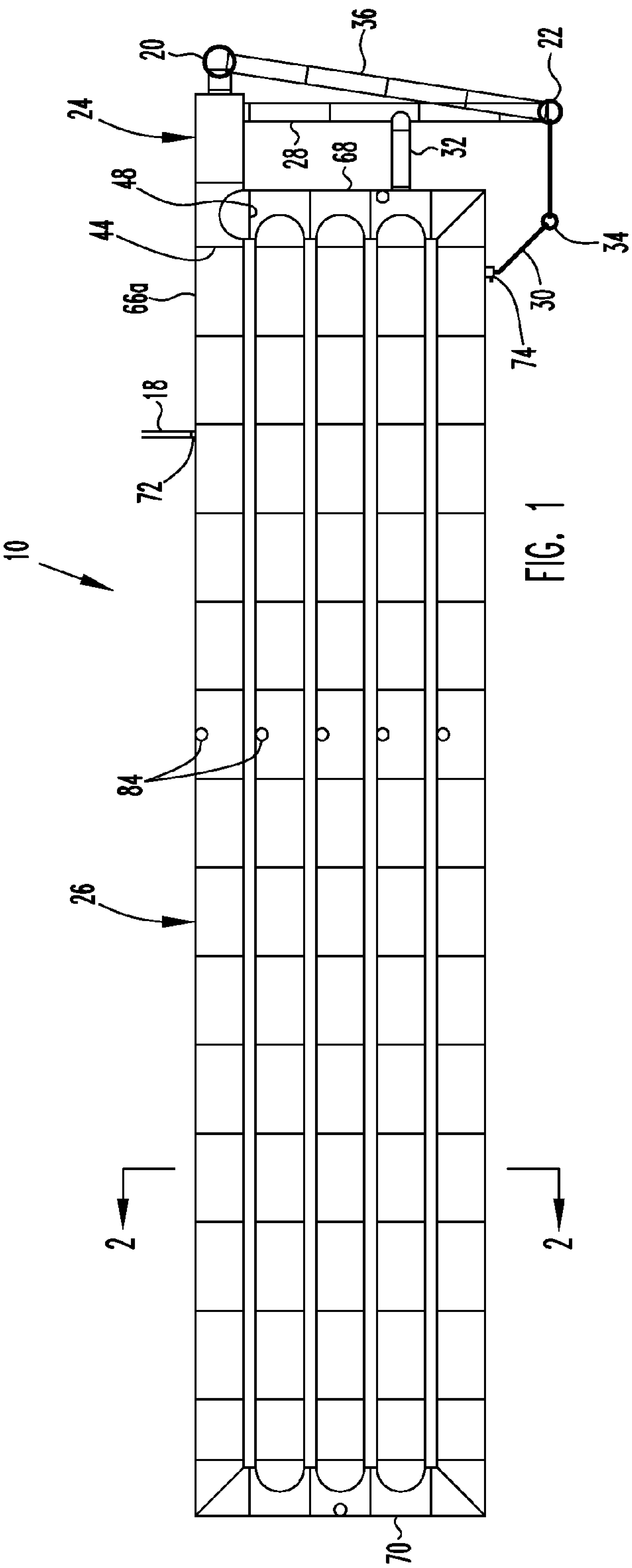
(57) **ABSTRACT**

An underground stormwater management system includes a receiving tank connected to a source of non-first flush runoff and a storage chamber that accumulates stormwater runoff for discharge to a storm drain. The storage chamber includes a first inlet connected to a source of first flush runoff, a second inlet connected to receive overflow from the receiving tank, a first discharge and a second discharge above the first discharge. First flush is discharged from the first discharge and is filtered before reaching the storm drain. The receiving tank assists in delaying the receipt of non-first flush runoff into the storage chamber during a major rain event. During major rain events runoff is also discharged from the storage chamber directly to the surrounding media.

28 Claims, 7 Drawing Sheets

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20
36
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FIG. 1

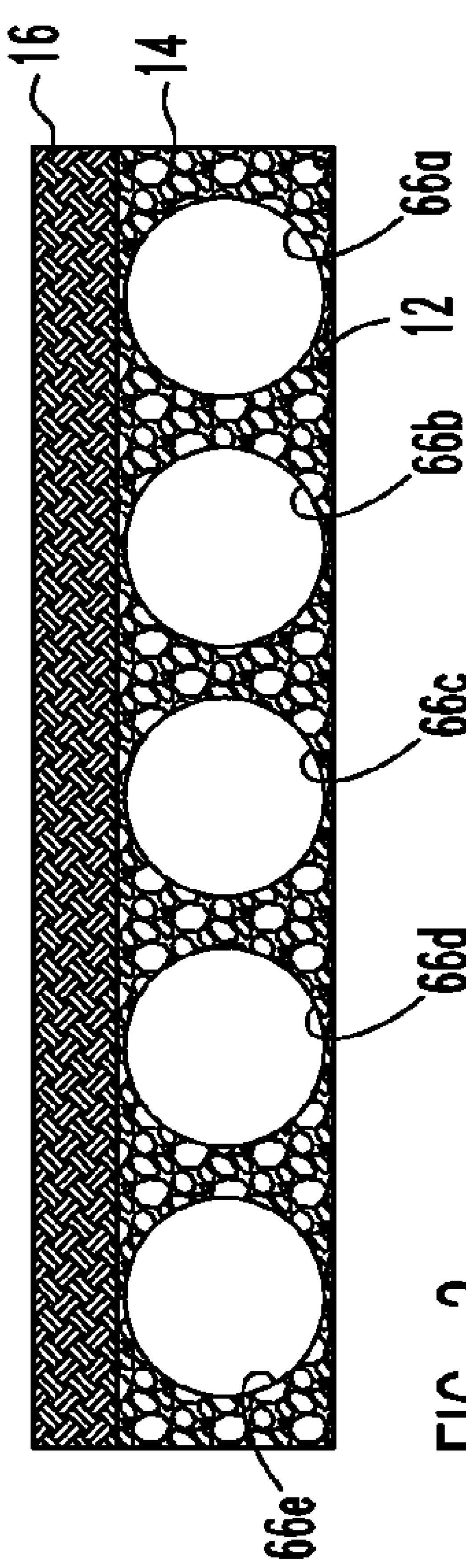
16
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FIG. 2

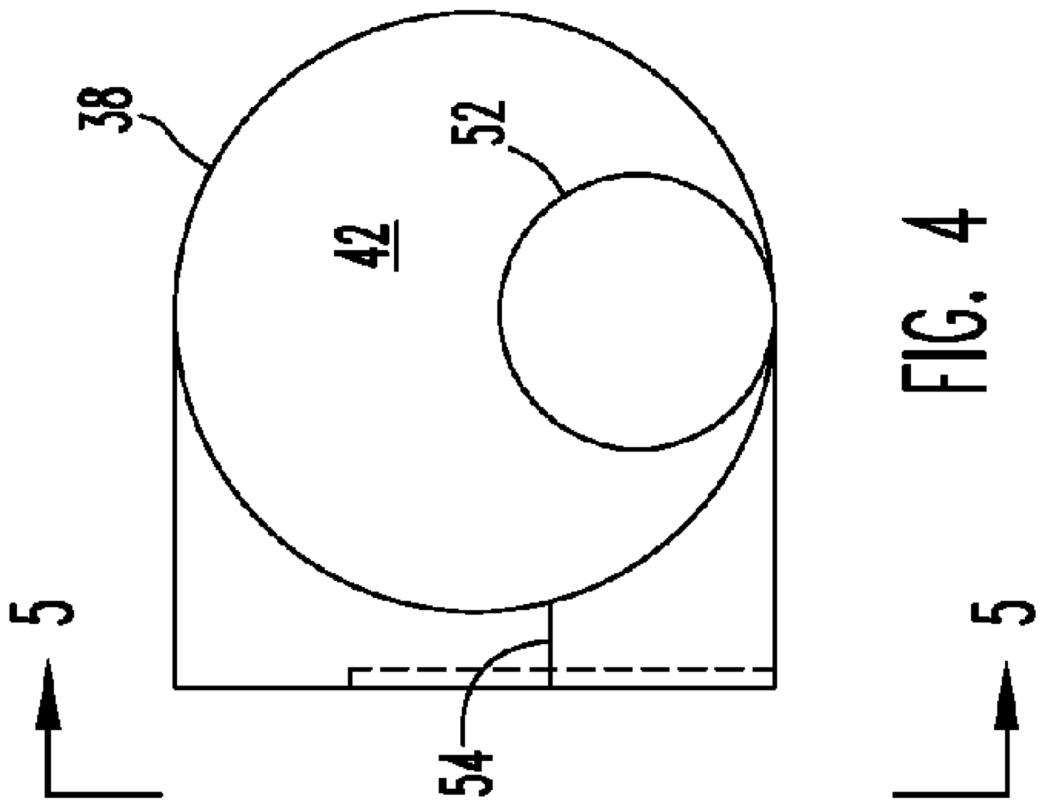

FIG. 4

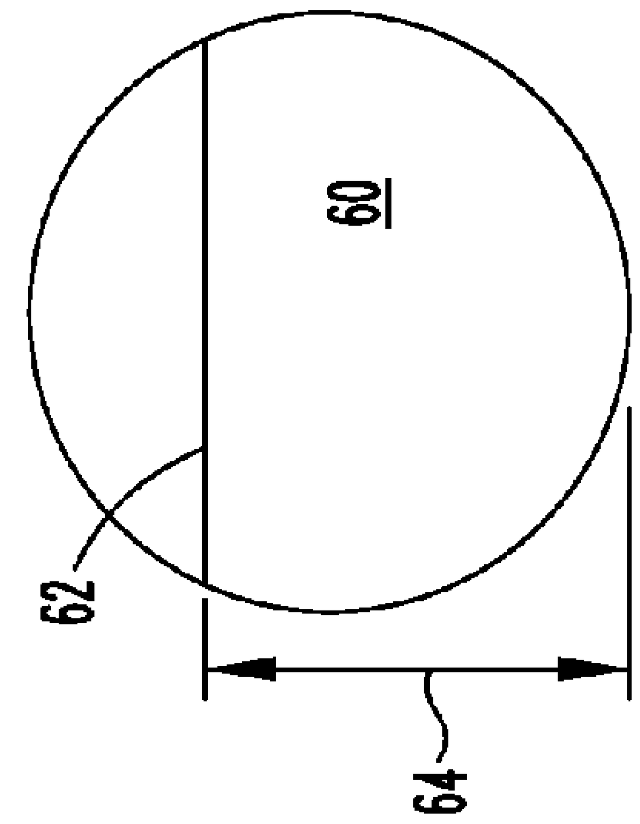

FIG. 6

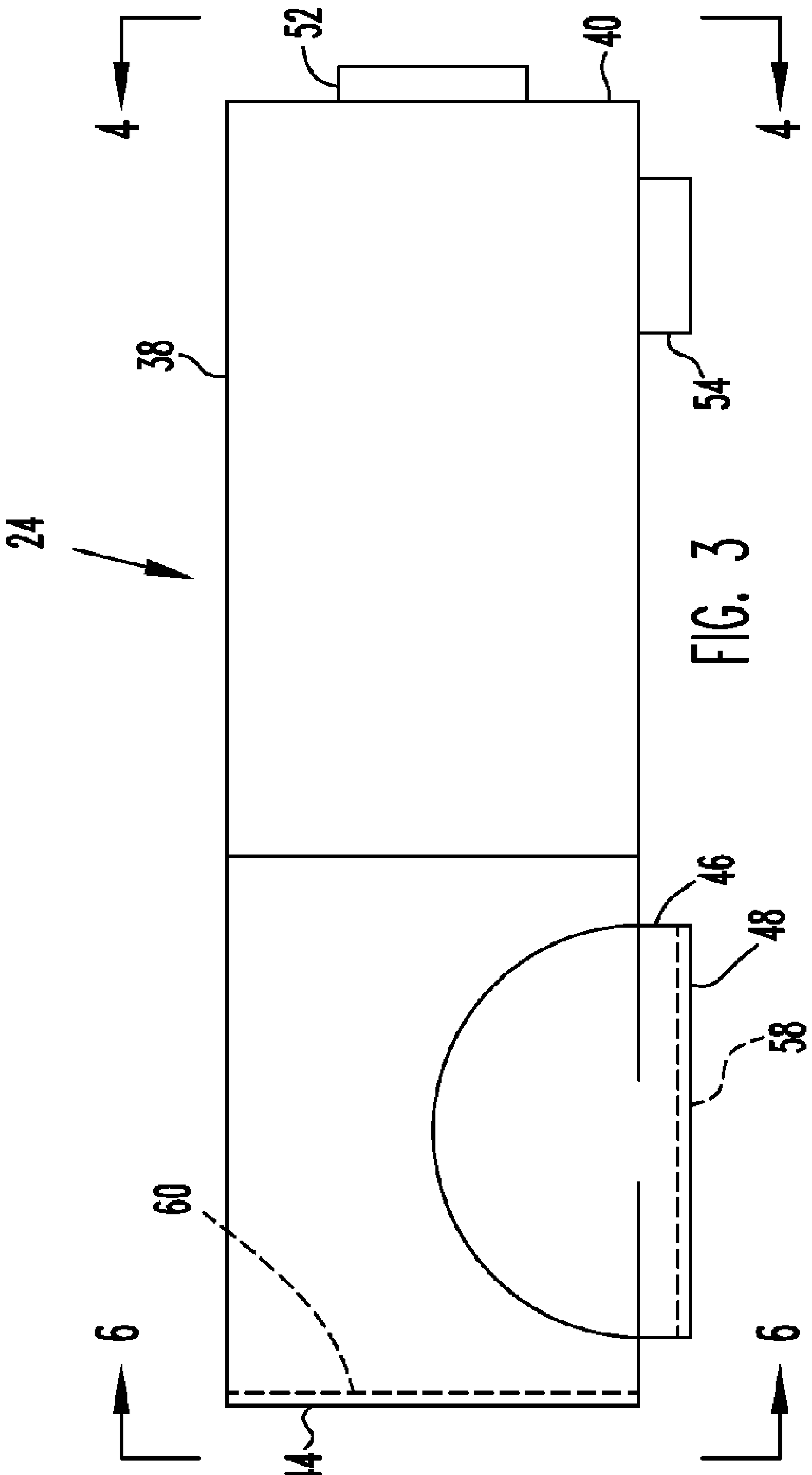

FIG. 3

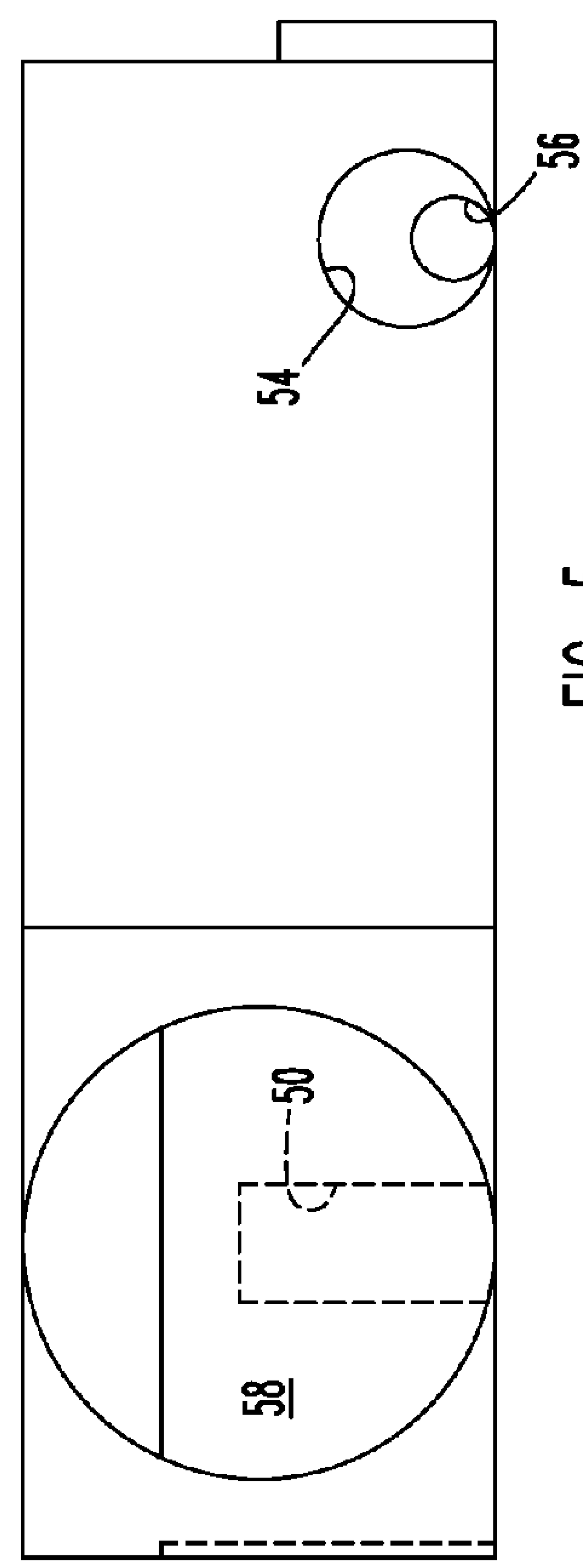

FIG. 5

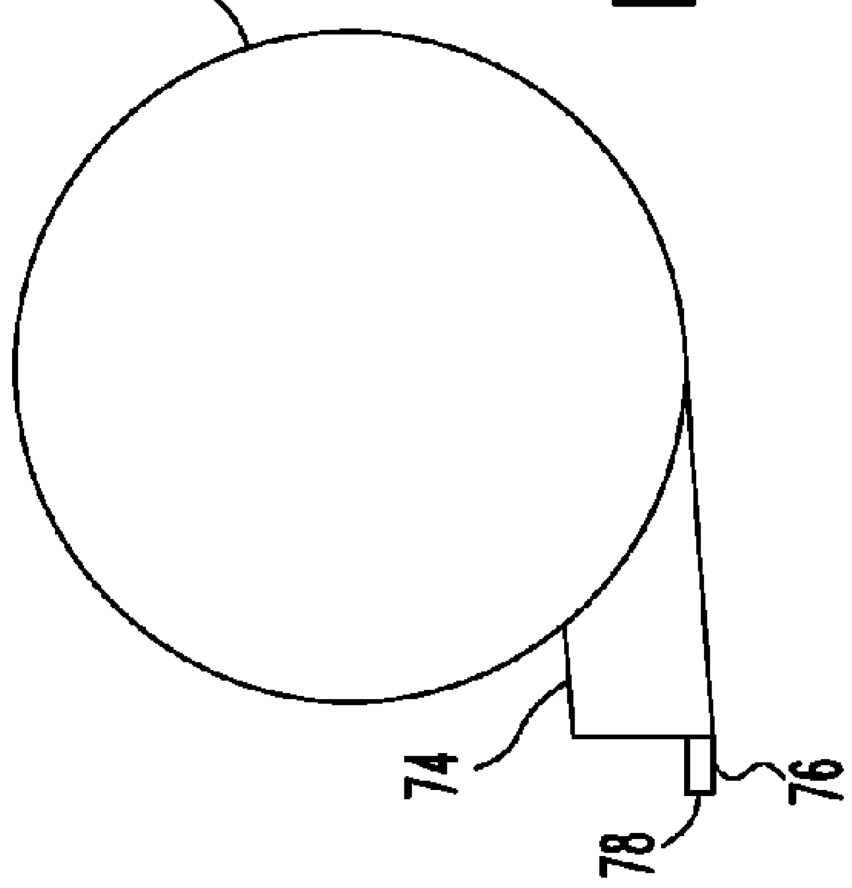

FIG. 8

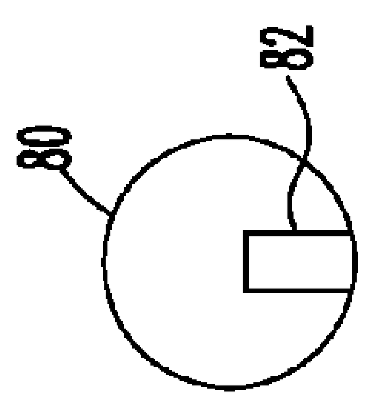

FIG. 10

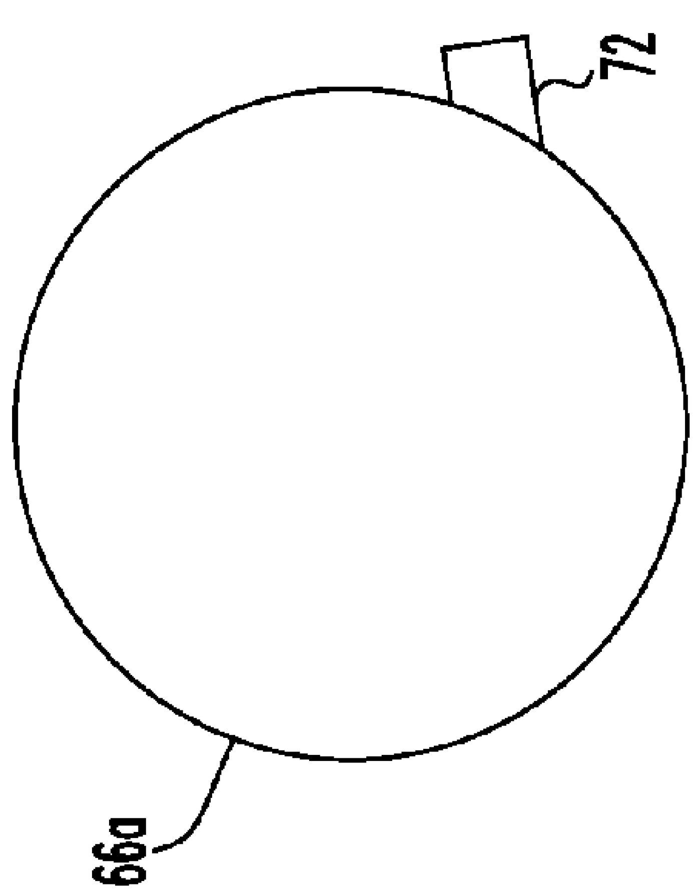

FIG. 7

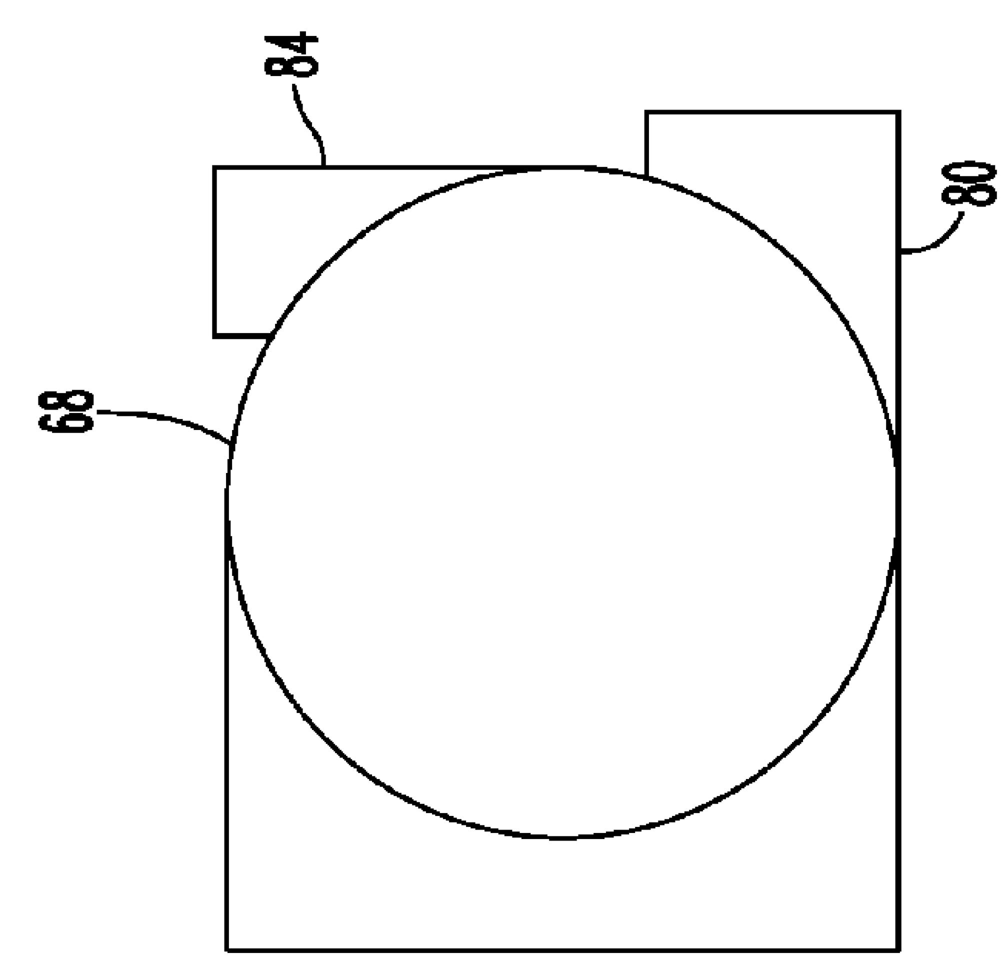

FIG. 9

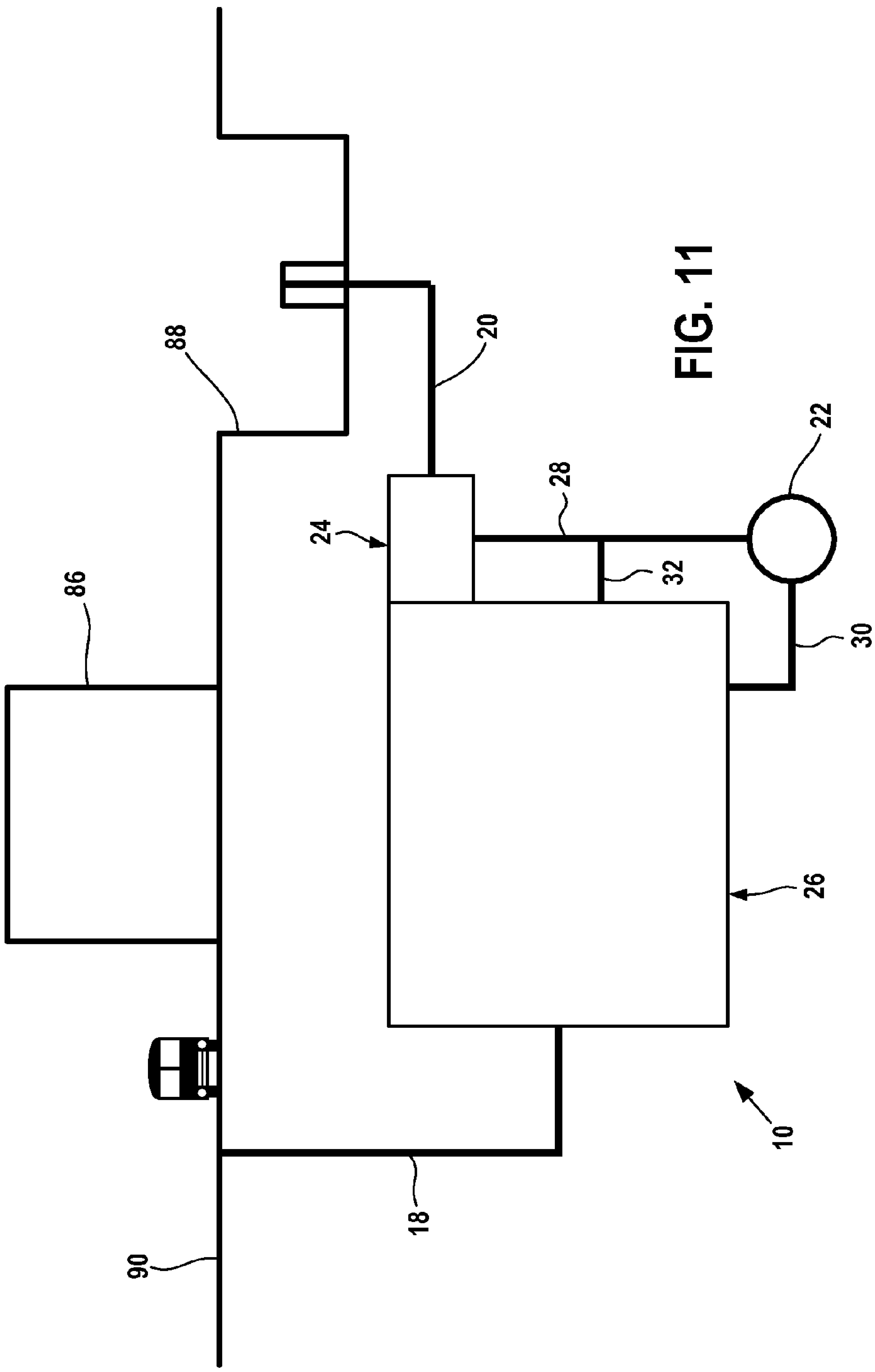

FIG. 11

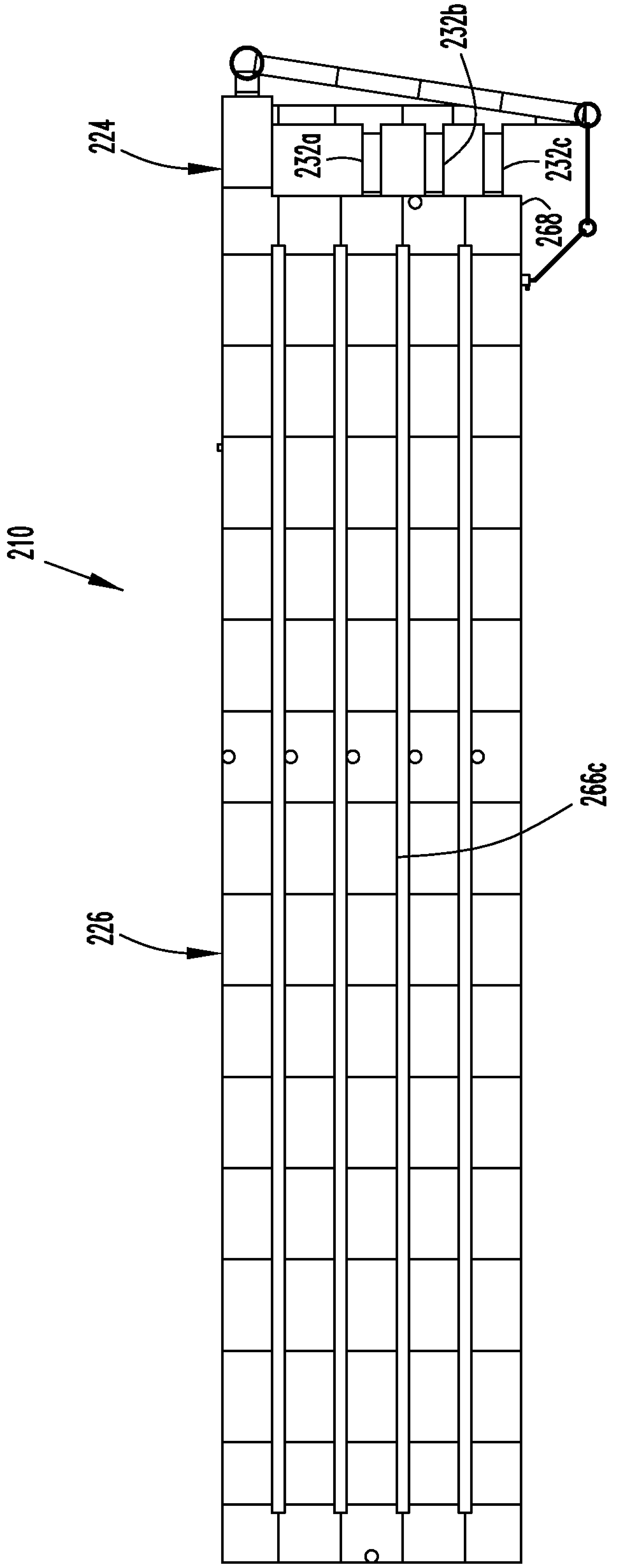

FIG. 12

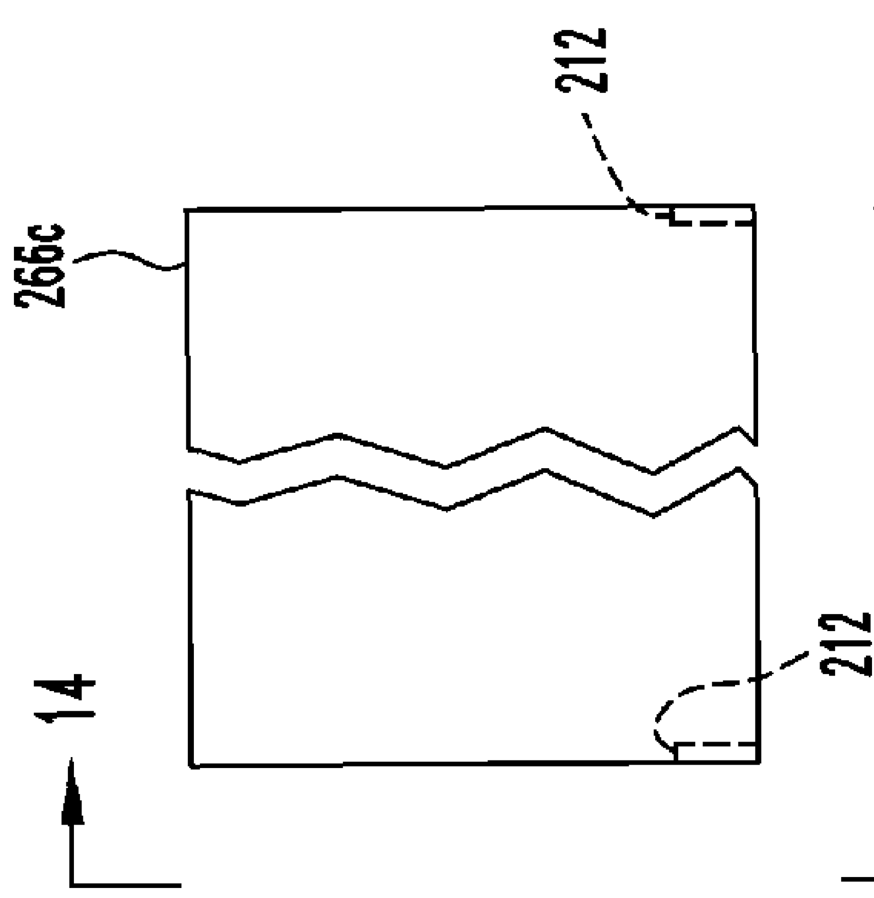

FIG. 13

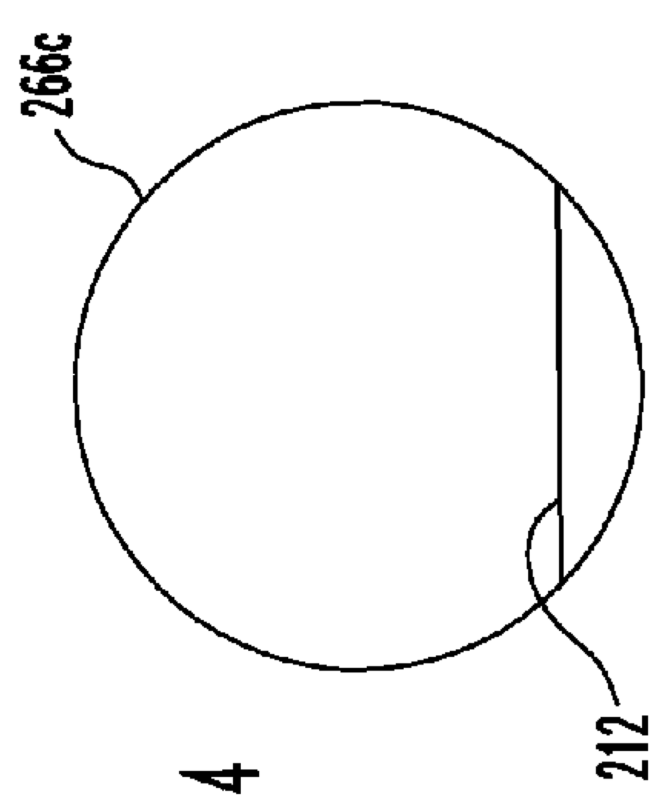

FIG. 14

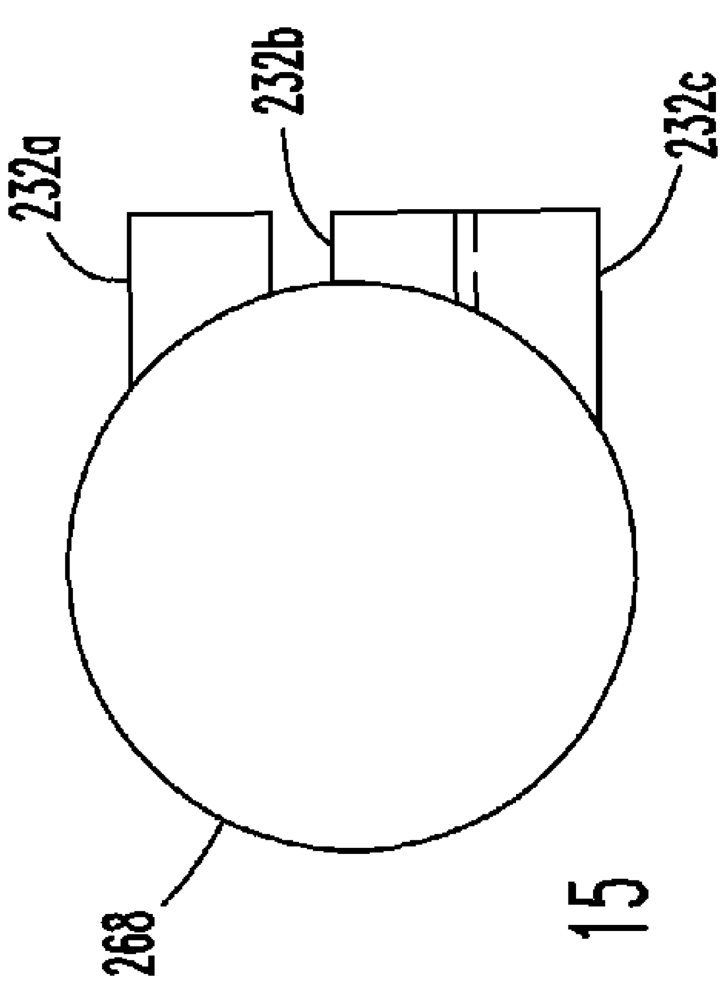

FIG. 15

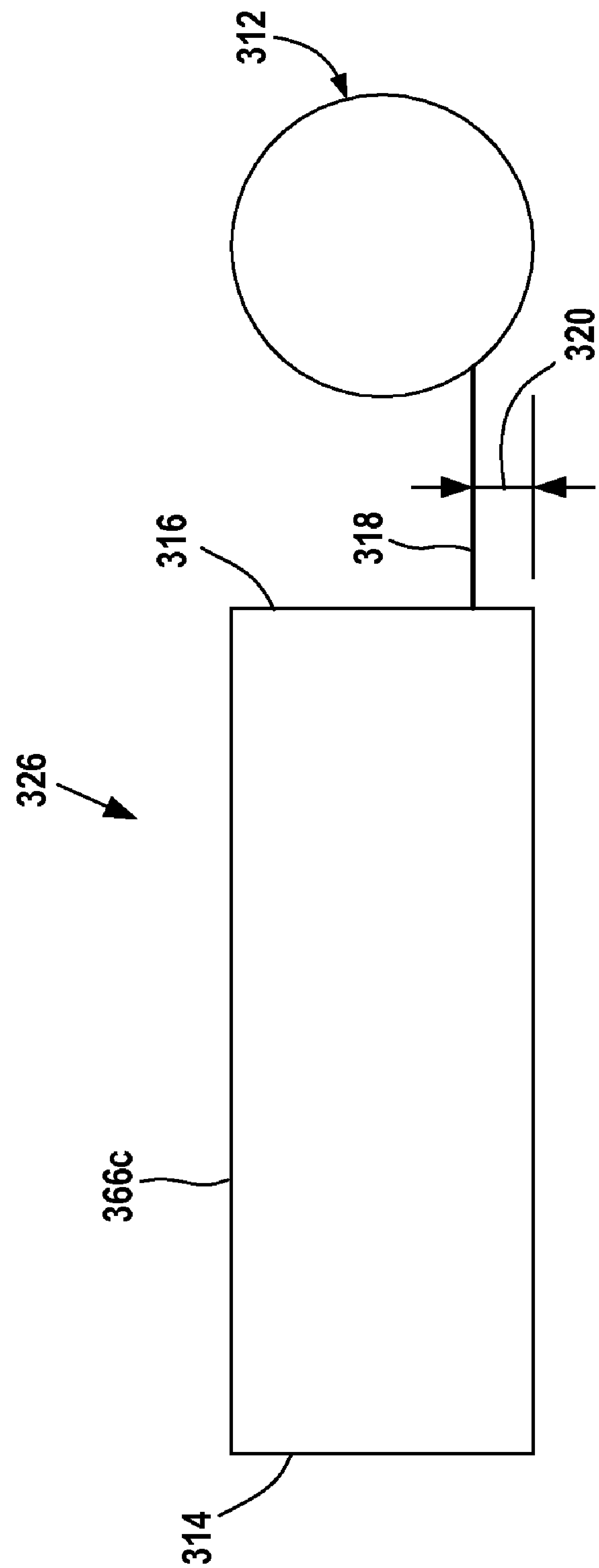

FIG. 16

UNDERGROUND STORMWATER MANAGEMENT SYSTEM AND METHOD

This application claims priority to my U.S. Provisional Patent Application No. 61/085,062 filed Jul. 31, 2008.

FIELD OF THE INVENTION

The invention relates generally to stormwater treatment, and particularly to an underground stormwater management system and method for receiving and discharging stormwater runoff to a storm drain.

BACKGROUND OF THE INVENTION

Stormwater runoff includes the initial runoff or "first flush" that contains sediments, oil, and other pollutants flushed from surface areas, and other runoff that can be considered essentially pollution-free. The pollution-free runoff includes the later runoff from the surface areas that generated the first flush, and runoff from areas without surface pollutants. In major storm events the volume of non-first flush is substantially greater than the volume of first flush.

Stormwater treatment systems have been developed to remove pollutants from the first flush. Conventional first flush treatment systems include systems that pass the first flush through a filter to remove pollutants. The filter can be a relatively inexpensive low-head filter because of the relatively low volume and flow of runoff to be filtered.

Underground stormwater management systems have also been developed that receive runoff at a high rate during a major storm event, and discharge the runoff at a lower rate to a storm drain. Such systems include an underground storage chamber that receives and stores the water that accumulates while the flow into the storage chamber is greater than the discharge out. The water discharges at a relatively high head from the storage chamber to enable discharge near the maximum discharge rate allowed by applicable law or regulation. The discharge is normally not filtered, but if filtering is desired an expensive high-head filter must be used because of the high volume and flow of runoff being filtered.

Sites such as shopping centers, business parks, and other developed areas often use separate stormwater treatment systems and underground stormwater management systems. The stormwater treatment system is connected to surface areas that generate relatively low volume first flush, while the underground stormwater management system is capable of receiving and accumulating a large volume of non-first flush runoff from major storm events. Building and maintaining two stormwater systems is expensive and can be difficult to locate on some sites.

Thus there is a need for an improved underground storage system that can receive both receives and filters first flush and stores and accumulates large amounts of non-first flush runoff during major storm events without the need for an expensive, high-head filter.

SUMMARY OF THE INVENTION

The invention is an improved underground stormwater management system that receives and filters first flush and stores and accumulates large volumes of runoff without using an expensive high-head filter.

The underground stormwater management system in accordance with the present invention manages the flow of runoff to a stormwater drain. The system includes a storage chamber defining an interior for receiving and discharging runoff, a filter outside of the storage chamber, a first discharge line to flow runoff from the storage chamber to the stormwater drain, and a second discharge line to flow runoff from the storage chamber to the stormwater drain.

The storage chamber includes an inlet to receive runoff into the interior of the storage chamber, a first discharge outlet to discharge runoff from the interior of the storage chamber into the first discharge line, and a second discharge outlet to discharge runoff from the interior of the storage volume into the second discharge line.

The first outlet is at a first elevation and the second outlet is at a second, higher elevation than the first outlet, the first elevation corresponding to a first volume of runoff in the interior of the storage chamber and the second elevation corresponding to a second, greater volume of runoff in the interior of the storage chamber. The storage chamber must fill to at least the greater volume before reaching the second outlet. The filter is in the first discharge line to filter runoff flowing through the first outlet line.

During a storm event first flush is received into the storage chamber. The first flush is discharged through the first discharge opening while the water level in the storage chamber is below the second discharge opening. The filter filters the first flush before the first flush reaches the storm drain.

Non-first flush is received in the storage chamber after the storage chamber began receiving the first flush. The flow of non-first flush may be sufficient to raise the water level in the storage chamber above the second discharge opening. Runoff in the storage chamber is discharged simultaneously through the first and second discharge openings while the water level in the storage chamber is at or above the second discharge opening, the discharge through the second discharge opening preferably not being filtered.

The underground stormwater management system takes advantage of first flush arriving at the storage chamber before the non-first flush. The delay in arrival of the non-first flush enables the first flush to be received into the storage chamber and to begin being discharged through the filter before the receipt of the non-first flush. Because of the relatively large volume of the storage chamber and the relatively small volume of first flush, an inexpensive low-head filter can be used in the first discharge line.

In a preferred embodiment of the invention the storage chamber is fluidly connected to a receiving tank that receives the non-first flush. The receiving tank includes a discharge that discharges to the second discharge line. Overflow from the receiving tank flows into the storm chamber. The time needed to overflow the receiving tank adds to the delay between receipt of first flush and the receipt of non-first flush in the storage chamber. The receiving tank is preferably sized such that in many rain events the receiving tank does not overflow, and none of the non-first flush flows into the storage chamber.

During a severe rain event, the receiving tank must overflow before discharging to the storage chamber. The additional delay needed for the receiving tank to fill to overflowing provides additional time for the first flush to discharge from the storage chamber before the storage chamber receives runoff from the receiving tank. Preferably the receiving tank is sized to permit all the first flush to be discharged from the storage chamber before the receiving tank overflows.

The storage chamber in some embodiments includes a perforated storage section or portion that enables runoff in the perforated storage portion to discharge directly into surrounding permeable media. This enables the surrounding media to increase the effective storage capacity of the system.

The perforated storage portion may be configured or arranged such that the water level in the storage chamber must exceed a predetermined minimum elevation before runoff flows into the perforated storage portion. The storage chamber is preferably sized such that first flush does not reach the water level necessary for substantial flow into the perforated storage portion so that no first flush, or essentially no first flush, is discharged through the perforated storage portion into the surrounding media.

The underground stormwater management system of the present invention is capable of both treating first flush and storing and accumulating a large volume of runoff using the same storage chamber. There is no need for separate stormwater treatment and stormwater management systems, thereby reducing cost and making more efficient use of the site in managing stormwater runoff.

Other objects and features of the present invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying seven drawing sheets illustrating three embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top view of an underground stormwater management system (USMS) in accordance with the present invention;

FIG. **2** is a sectional view taken along lines **2-2** of FIG. **1**, the USMS buried below grade;

FIG. **3** is a top view of the receiving tank of the USMS shown in FIG. **1**;

FIG. **4** is a side view of the receiving tank taken along lines **4-4** of FIG. **3**;

FIG. **5** is a front view of the receiving tank taken along lines **5-5** of FIG. **4**;

FIG. **6** is a side view of the body of the receiving tank taken along lines **6-6** of FIG. **3**;

FIG. **7** is an end view of a storage tank of the USMS shown in FIG. **1**;

FIG. **8** is an end view of another storage tank of the USMS shown in FIG. **1**;

FIG. **9** is an end view of the front storage tank of the USMS shown in FIG. **1**;

FIG. **10** is a view of the discharge orifice in the front storage tank shown in FIG. **9**;

FIG. **11** is a representational view of the USMS shown in FIG. **1** installed at a site of a shopping center site to manage stormwater runoff at the site;

FIG. **12** is a top view similar to FIG. **1** of a second embodiment underground stormwater management system in accordance with the present invention;

FIG. **13** is a side view of the perforated storage tank of the USMS shown in FIG. **12**;

FIG. **14** is an end view of the perforated storage tank taken along lines **14-14** of FIG. **13**;

FIG. **15** is an end view of the front storage tank of the USMS shown in FIG. **12**; and

FIG. **16** is a schematic view of a third embodiment underground stormwater management system in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. **1** and **2** illustrate an underground stormwater management system (USMS) **10** in accordance with the present invention. Illustrated USMS **10** is formed primarily from lengths of twelve-foot diameter corrugated aluminized pipe. USMS **10** is buried in a trench **12** below field grade. The trench is backfilled with a permeable media **14**, the permeable media **14** surrounding the USMS **10**. A suitable permeable media is clean #57 open graded stone backfill or equivalent. The remainder of the trench is filled with a non-permeable media **16** to grade level, and the entire trench is preferably wrapped in a nonwoven filter fabric.

Illustrated USMS **10** receives runoff water from a first incoming storm drain **18** and a second incoming storm drain **20**, and discharges water to an outgoing storm drain **22** that carries the water off site.

USMS **10** includes an inlet tank or receiving tank **24** that receives and accumulates runoff from a relatively small diameter storm drain **18**, and a storage chamber **26** that receives and accumulates runoff from a relatively large diameter storm drain **20**. The receiving tank **24** discharges water through a main discharge pipe **28** extending from the inlet tank **20** to the storm drain **18**. During a major storm event the receiving tank **24** also discharges overflow into the storage chamber **26** as will be explained in more detail later below.

Storage chamber **26** discharges water through a first discharge pipe **30** and a second discharge pipe **32**. Discharge pipe **30** extends from the storage chamber **26** to the storm drain **22**, and slopes downwardly to an inline filter **34**. Discharge pipe **32** extends from the storage chamber **26** and discharges into the main discharge pipe **28** downstream from the inlet tank **24**.

Filter **34** removes pollutants and sediment from water flowing through pipe **30** prior to the water reaching the storm drain **22**. Suitable filters are commercially available and known in the art, and so the filter **34** will not be described in detail.

A bypass pipe **36** extends from the second incoming storm drain **20** to the discharge storm drain **22** and permits runoff to fully or partially bypass the USMS **10** in the event of rare storm events or obstructions.

FIGS. **3-6** illustrate receiving tank **24** separate from the remainder of USMS **10**. Receiving tank **24** includes a tubular body **38** having a first end **40** closed by a bulkhead **42** and an opposite open end **44**. A right-angle tubular extension **46** extends from the body to an open end **48**. An opening **50** in the body **38** communicates the interior of the body with the interior of the extension. An inlet pipe stub **52** extends through the bulkhead **42** to flow water from the inlet drain **20** into the receiving tank **24**. An outlet pipe stub **54** located near the bottom of the body **38** attaches to the end of the main discharge pipe **28**. A reduced-diameter discharge opening or discharge orifice **54** formed in the body wall at the bottom of the pipe stub **52** discharges water out of the receiving tank **24** into the discharge pipe **28**.

The open ends pipe ends **44**, **48** are each partially closed by respective weirs. Each weir is defined by a respective metal plate **58**, **60** that closes all but an upper portion of the pipe end. Each weir plate **58**, **60** has an upper end **62** spaced a predetermined elevation **64** above the bottom of the receiving tank **24**. The elevation of the upper ends of the weir plates defines the maximum interior storage volume of the receiving tank **24** without water spilling over the weir plates.

Referring back to FIGS. **1** and **2**, the storage chamber **26** includes a horizontal array of tubular storage tanks **66** connected by front and rear storage tanks **68**, **70**. Front storage tank **68** extends parallel with the main discharge pipe **28**. The illustrated storage array includes tanks **66***a*, **66***b*, **66***c*, **66***d*, and **66***e* spaced apart from one another and arranged in parallel. The storage tanks **66**, **68**, **70** are each at the same elevation.

The storage chamber **26** is fluidly connected to the receiving tank **24**. One end of storage tank **66***a* is connected to the end **44** of the receiving tank. One end of the front storage tank **68** is attached to the other end **48** of the receiving tank. Weir plates **58**, **60** separate the interior of the receiving tank **24** from the interior of the storage chamber **26**.

An inlet pipe stub **72** defining an inlet opening extends into the storage tank **66***a* and connects the storage chamber **26** with the first incoming storm drain **18**. See also FIG. **7**. An outlet pipe stub **74** extends downwardly from near the bottom storage tank **66***e* to below the storage tank **66***e*, connecting the storage chamber **26** with the first discharge pipe **30**. See also FIG. **8**. As shown in FIG. **8** a reduced-diameter pipe **76** defines a discharge opening or discharge orifice **78** that discharges water out of the storage tank and into the first discharge pipe **30**. The discharge opening **78** defines the lowest elevation of the storage chamber **26** such that the opening **78** can drain the storage chamber **26**.

An outlet pipe stub **80** extends outwardly from the front storage tank **68** towards the main discharge line, connecting the storage tank **26** with the second discharge pipe **32**. See FIG. **9**. A discharge opening **82** (see FIG. **10**) formed in the wall of the storage tank **68** defines a discharge opening or discharge orifice that that is significantly larger than the discharge opening **78**. The discharge opening **82** is higher in elevation than the discharge opening **78**.

Each storage tank **66**, **68**, **70** is formed from the aluminized corrugated pipe referred to above. Storage tanks **66***a*, **66***b*, **66***d*, and **66***e*, and front and rear storage tanks **68**, **70** are formed from solid pipe, that is, pipe having solid, non-perforated walls. The solid walls prevent direct fluid communication between water in the pipe and the surrounding media **14**. These storage tanks with solid walls define a solid storage portion of the storage chamber **24**.

Storage tank **66***c* is formed from perforated pipe, that is, pipe having apertures or holes extending through the pipe walls. The perforated pipe enables direct fluid communication between water in the pipe and the surrounding media **14**, allowing water to discharge directly from the storage tank **66***c* into the permeable medium **14**. Storage tank **66***c* defines a perforated storage portion of the storage chamber **26**.

Vertical cleanout or access risers **84** can also be provided for access to the USMS **10** after installation (see FIGS. **1** and **9**).

The operation of USMS **10** will now be described with respect to storm events of increasing severity. For the non-limiting purpose of illustration it is assumed USMS **10** manages stormwater runoff at a shopping center **86** that has a detention basin **88** and includes a parking lot **90**. See FIG. **11**. The detention basin **88** is connected to the USMS **10** by the storm drain **20**, and the storm drains of the parking lot **90** are connected to the USMS **10** by the storm drain **18** as illustrated in FIG. **11**.

The detention basin **88** discharges non-first-flush water, that is, the runoff stored in the detention basin **88** can be considered substantially free of contaminants and pollutants. The runoff received in the detention basin **88** can be either on-site or off-site runoff.

The parking lot **90** is a source of first flush. For purposes of discussion it is assumed that the first flush is generated from the first half-inch of rainfall, and that runoff from the parking lot after the first half-inch of rainfall can be considered non-flush runoff essentially free of contaminants and pollutants. It is also assumed for illustration that flow from the detention basin **88** occurs after an inch of rain has fallen.

The first example storm event is a storm event that is a half-inch or less. The USMS **10** receives runoff only from the parking lot **90**, and begins receiving runoff essentially at the start of the rain event. The parking lot runoff flows through inlet storm drain and flows directly into the storage chamber **26** of USMS **10** through inlet **74**. The runoff received into the storage chamber **26** is entirely first flush. The relatively large volume of the storage chamber **26** is sufficient to prevent the water level in the storage chamber **26** from reaching the elevation of the second discharge outlet **82**.

The first-flush received from the parking lot **90** is discharged solely through the first discharge line **30** and is filtered by the filter **34** before reaching the storm drain **22**. The relatively low water level in the storage tank and the relatively small discharge opening **78** causes flow through the discharge line **30** at a relatively low head, permitting the use of a low-head filter for filter **34**.

In the illustrated embodiment the volume of the pipe stub **74** and the volume of the discharge pipe **30** from the pipe stub **74** to the filter **34** is sufficient to store essentially all the first flush. This enables the first flush to be discharged from the discharge outlet **78** at about the same rate as the flow of first flush into inlet **72** and minimizes the water level in the storage chamber **26**. Because of the low water level little or no first flush flows into the perforated storage tank **66***c*.

In a second rain event, the storm event exceeds one-half inch but does not exceed one inch. The USMS **10** receives runoff only from the parking lot **90**. Like the first rain event, the relatively large volume of the storage chamber **26** is sufficient to prevent the water level in the storage chamber **26** from reaching the elevation of the second discharge outlet **82**. The first flush and the runoff received after the first flush is discharged at relatively low head through the discharge line **30** and is filtered before reaching storm drain **22** as previously described.

In a third, more severe rain event, the rainfall exceeds one inch. This is sufficient to generate flow from the detention basin **88**. During the first inch of rainfall, the USMS **10** receives runoff only from the parking lot **90**. The first flush discharges through the discharge pipe **30** and is filtered by filter **34** as previously described.

Initial receipt of runoff from the detention basin **88** does not occur at the start of the rain event, but is delayed for the time needed for the detention basin to fill and begin discharging runoff.

The runoff from the detention basin **88** flows via drain **20** into the receiving tank **24** and is discharged through the receiving tank discharge opening **56** to the main discharge pipe **28**. As the water level in the receiving tank **24** increases, the hydraulic head at the discharge opening **56** increases and the flow into the discharge pipe **28** increases. The size and shape of the discharge opening, and the rate of change in water level, can be designed to meet the discharge needs of the site. The storm event is not severe enough to cause the water in the receiving tank **26** to flow over the weirs **58**, **60**, and so none of the runoff from the detention basin **88** flows into the storage chamber **26**.

Storage chamber **26** does continue to receive runoff from the parking lot **90** in parallel with the receipt of runoff into the receiving tank **24**, and continues to discharge low head flow through the discharge pipe **30**.

If the water level in storage chamber **26** reaches the second discharge opening **82**, the increased water level generates additional discharge through the main discharge pipe **28**. This additional discharge from the storage chamber **26** is not first flush, and flows directly through the main discharge pipe **28** without being filtered before discharging into the storm drain **22**. The relatively small first discharge opening **78** and relatively small diameter discharge pipe **30** ensures low head flow through the filter **34** despite the increase in water level in the storage chamber **26**.

In a fourth, even more severe rain event, the flow into the receiving tank **24** is sufficient to overflow the weirs **58**, **60** and the overflow enters the storage chamber **26**. The storage chamber **26** provides the ability to store and delay the discharge of such excess runoff. Water is discharged from the storage chamber **26** primarily through the discharge opening **82**, but also discharges through the discharge opening **78** at low head as previously described. All the discharge openings are cooperatively sized to discharge water to the storm drain **22** at a flow rate not greater than the rate authorized by law or regulation.

FIG. **12** illustrates a second embodiment USMS **210** that includes a receiving tank **224** identical to the receiving tank **24** and a storage chamber **226** similar to storage chamber **226**. Only the differences between storage chamber **26** and storage chamber **226** will be discussed, it being understood the other elements remain the same as previously described.

USMS **210** includes a perforated storage tank **266***c* similar to perforated storage tank **66***c*. The open ends of the tank **266***c* are partially closed by weirs formed by respective weir plates **212**. See FIGS. **13** and **14**. The illustrated weir plates **212** each extends upwardly from the bottom of the storage tank to an upper edge located one foot, nine inches above the bottom of the storage tank.

USMS **210** also replaces the single discharge **32** with multiple discharge pipes **232***a*, **232***b*, and **232***c* spaced along the length of the front storage tank **268**. See FIGS. **12** and **15**. The multiple discharge pipes **232** communicate with the main discharge pipe **228** through respective discharge openings or discharge orifices formed in the wall of the front storage tank **268**. The number of discharge openings, their shapes, areas, and relative elevations can be varied as needed to meet discharge requirements at the site.

Operation of USMS **210** is similar to USMS **10**. The weirs **212** obstruct the flow of first-flush into the ends of the perforated storage tank **266***c*, preventing first flush from entering the perforated storage tank **266***c* during the initial receipt of runoff into the USMS **210**. This enables the storage chamber **226** to accumulate an additional volume of first flush without the first flush entering the perforated storage tank **266***c*, preventing first flush from being discharged directly into the porous media surrounding the tank **266***c*.

Preferably the bottom of the lowest of the discharge openings associated with the discharge pipes **232** is spaced at or above the top of the weirs **212**. This way first flush received into the storage chamber **226** flows to the discharge **230** only through solid storage portion and is discharged from the storage tank **226** only through the discharge **230**.

The multiple discharge openings **232** increase the number of active discharge openings discharging into the main discharge pipe **218** during major rain events. As the water level in the storage chamber **226** increases, the effective area of the discharge openings discharging into the pipe **218** increases. The number of discharge openings, their shapes and areas, and relative elevations can be varied as needed to meet discharge requirements for different year events at the site.

Storage chamber **226** has a perforated storage portion formed by tubular storage tank **266***c*, with the perforated storage portion arranged hydraulically in parallel with a portion of the solid storage portion of the storage chamber between the inlet and discharge of the storage chamber. This enables first-flush to flow from the inlet to the discharge only through the solid storage portion of the storage chamber **226** when the water level is below the top of the weirs **212**.

FIG. **16** illustrates schematically a portion of a third embodiment storage chamber **326** similar to storage chamber **26**. The storage chamber **326** includes a perforated storage tank **366***c* located to one side of a solid storage portion **312**. The solid storage portion **312** defines a flow path extending between the inlets and discharges of the storage chamber **326** as previously described.

Bulkheads **314**, **316** close the ends of the storage tank **366***c*. A flow conduit **318** fluidly connects one end of the storage tank **366***c* to the solid storage portion **312**. The relative elevation **320** of the flow conduit **318** establishes the water level at which water flows from the solid storage portion into the perforated storage portion, and performs essentially the same function as the weirs **212** to prevent flow into the perforated storage portion and then to the surrounding media until the water level in the solid storage portion reaches a predetermined elevation.

In yet other embodiments the perforated storage portion could be placed at a higher elevation than the solid storage portion, the difference in elevation performing the same function as the weirs **212** in preventing flow into the perforated storage portion and then into the surrounding media until the water level in the solid storage portion reaches a predetermined elevation.

In still yet other embodiments only the lower portion of perforated pipe has a solid wall, and the upper portion of the perforated pipe has a perforated wall. The water level in the perforated pipe must reach the level of the perforated wall to pass through the pipe wall. The difference in elevation between solid and perforated wall portions performs the same function as the weirs **212** in preventing the flow into the perforated storage portion and into the surrounding media until the water level in the solid storage portion reaches a predetermined elevation. Other configurations are possible and could be adapted to meet site requirements.

It should be understood that while the illustrated underground storm management structures illustrated herein are fabricated primarily from large diameter pipe, equivalent structures can be fabricated using plates, box structures, and the like.

Furthermore in alternative embodiments the perforated storage portion of the storage chamber can be formed from different structures than the solid storage portion. For example, arch-shaped members having open floors can be used instead of perforated pipe in the perforated storage portion. An example of an arch-shaped member that can be adapted for use in the present invention is disclosed in Maestro U.S. Pat. No. 6,361,248.

The relative sizes of the receiving tank and storage tank, inlet and outlet locations and sizing, and other design parameters of the underground stormwater management system of the present invention can be modeled using hydraulic design software to meet site-specific design requirements.

While I have illustrated and described a preferred embodiment of my invention, it is understood that this is capable of modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

What I claim as my invention is:

1. An underground stormwater management system to manage the flow of runoff to a stormwater drain, the system comprising:

a storage chamber defining an interior for receiving and discharging runoff, a receiving tank, a filter outside of the storage chamber, a first discharge line to flow runoff from the storage chamber to the stormwater drain, and a second discharge line to flow runoff from the storage chamber to the stormwater drain;

the storage chamber comprising a first inlet, a second inlet spaced from the first inlet, a first discharge outlet and a second discharge outlet, the first and second inlets to receive runoff into the interior of the storage chamber, the first inlet to be connected to a first source of stormwater runoff and the second inlet to be connected to second source of stormwater runoff, the first discharge outlet to discharge runoff from the interior of the storage chamber into the first discharge line, the second discharge outlet to discharge runoff from the interior of the storage volume into the second discharge line, the first discharge outlet at a first elevation and the second discharge outlet at a second, higher elevation than the first outlet, the first elevation corresponding to a first volume of runoff in the interior of the storage chamber and the second elevation corresponding to a second, greater volume of runoff in the interior of the storage chamber whereby the storage chamber must fill to at least the greater volume before reaching the second discharge outlet;

the receiving tank to be connected to the second source of stormwater runoff and comprising an overflow outlet and a discharge opening, the overflow outlet fluidly connected to the second inlet of the storage chamber, the tank discharge opening to be fluidly connected to the storm drain, the tank discharge opening located at a lower elevation than the overflow outlet whereby the receiving tank must fill to a predetermined volume before overflowing stormwater runoff to the storage chamber; and

the filter in the first discharge line to filter runoff flowing through the first discharge line.

2. The underground stormwater management system of claim **1** wherein the first discharge outlet of the storage chamber is located at essentially the lowest elevation of the storage chamber.

3. The underground stormwater management system of claim **1** wherein the first discharge outlet of the storage chamber has a first cross-sectional area and the second outlet of the storage chamber has a second, larger cross-sectional area.

4. The underground stormwater management system of claim **1** wherein the second discharge outlet of the storage chamber comprises a plurality of discharge openings.

5. The underground stormwater management system of claim **4** wherein the discharge openings of the storage chamber's second discharge outlet are spaced apart in elevation from one another whereby the storage chamber must fill to successively greater volumes to reach the successively higher discharge openings of the second discharge outlet.

6. The underground stormwater management system of claim **1** wherein the storage chamber comprises a nonperforated portion and a perforated portion, the nonperforated portion of the storage chamber defining a fluid path fluidly connecting the first inlet of the storage chamber and the first discharge outlet of the storage chamber.

7. The underground stormwater management system of claim **6** wherein the perforated portion of the storage chamber drains directly into a permeable media.

8. The underground stormwater management system of claim **6** wherein the perforated portion of the storage chamber is separated from the nonperforated portion of the storage chamber by a weir having a height wherein stormwater runoff in the nonperforated portion of the storage chamber must rise to the height of the weir before overflowing into the perforated portion.

9. The underground stormwater management system of claim **6** wherein the nonperforated portion of the storage chamber comprises a first storage tank having a respective lowest elevation and the perforated portion of the storage chamber comprises a second storage tank, the first and second storage tanks fluidly connected by a conduit having an elevation higher than the lowest elevation of the first storage tank whereby stormwater runoff in the first storage tank must rise to the elevation of the conduit before overflowing into the second storage tank.

10. The underground stormwater management system of claim **6** wherein the perforated portion of the storage chamber is disposed at a higher elevation than the nonperforated portion of the storage chamber.

11. The underground stormwater management system of claim **6** wherein the perforated portion of the storage chamber includes an upper portion, a lower portion, and perforations located in only the upper portion whereby stormwater runoff in the perforated portion of the storage chamber must rise to a level above the lower portion to be discharged through the perforations.

12. An underground stormwater management system to manage the flow of runoff to a stormwater drain, the system comprising:

a storage chamber defining an interior for receiving and discharging runoff, a receiving tank, a first discharge line to flow runoff from the storage chamber to the stormwater drain, and a second discharge line to flow runoff from the storage chamber to the stormwater drain;

the storage chamber comprising a first inlet, a second inlet spaced from the first inlet, a first discharge outlet and a second discharge outlet, the first and second inlets to receive runoff into the interior of the storage chamber, the first inlet to be connected to a first source of stormwater runoff and the second inlet to be connected to second source of stormwater runoff, the first discharge outlet to discharge runoff from the interior of the storage chamber into the first discharge line, the second discharge outlet to discharge runoff from the interior of the storage volume into the second discharge line, the first discharge outlet at a first elevation and the second discharge outlet at a second, higher elevation than the first outlet, the first elevation corresponding to a first volume of runoff in the interior of the storage chamber and the second elevation corresponding to a second, greater volume of runoff in the interior of the storage chamber whereby the storage chamber must fill to at least the greater volume before reaching the second discharge outlet; and

the receiving tank to be connected to the second source of stormwater runoff and comprising an overflow outlet and a discharge opening, the overflow outlet fluidly connected to the second inlet of the storage chamber, the tank discharge opening to be fluidly connected to the storm drain, the tank discharge opening located at a lower elevation than the overflow outlet whereby the receiving tank must fill to a predetermined volume before overflowing stormwater runoff to the storage chamber.

13. The underground stormwater management system of claim **12** wherein the first discharge outlet of the storage chamber is located at essentially the lowest elevation of the storage chamber.

14. The underground stormwater management system of claim **12** wherein the first discharge outlet of the storage chamber has a first cross-sectional area and the second outlet of the storage chamber has a second, larger cross-sectional area.

15. The underground stormwater management system of claim **12** wherein the second discharge outlet of the storage chamber comprises a plurality of discharge openings.

16. The underground stormwater management system of claim **15** wherein the discharge openings of the storage chamber's second discharge outlet are spaced apart in elevation from one another whereby the storage chamber must fill to successively greater volumes to reach the successively higher discharge openings of the second discharge outlet.

17. The underground stormwater management system of claim **12** wherein the storage chamber comprises a nonperforated portion and a perforated portion, the nonperforated portion of the storage chamber defining a fluid path fluidly connecting the first inlet of the storage chamber and the first discharge outlet of the storage chamber.

18. The underground stormwater management system of claim **17** wherein the perforated portion of the storage chamber drains directly into a permeable media.

19. The underground stormwater management system of claim **18** wherein the perforated portion of the storage chamber is separated from the nonperforated portion of the storage chamber by a weir having a height wherein stormwater runoff in the nonperforated portion of the storage chamber must rise to the height of the weir before overflowing into the perforated portion.

20. The underground stormwater management system of claim **17** wherein the nonperforated portion of the storage chamber comprises a first storage tank having a respective lowest elevation and the perforated portion of the storage chamber comprises a second storage tank, the first and second storage tanks fluidly connected by a conduit having an elevation higher than the lowest elevation of the first storage tank whereby stormwater runoff in the first storage tank must rise to the elevation of the conduit before overflowing into the second storage tank.

21. The underground stormwater management system of claim **17** wherein the perforated portion of the storage chamber is disposed at a higher elevation than the nonperforated portion of the storage chamber.

22. The underground stormwater management system of claim **17** wherein the perforated portion of the storage chamber includes an upper portion, a lower portion, and perforations located in only the upper portion whereby stormwater runoff in the perforated portion of the storage chamber must rise to a level above the lower portion to be discharged through the perforations.

23. A method of managing the stormwater runoff from a storm event to a stormwater drain, the method comprising the steps of:

(a) providing a storage chamber and a receiving tank to receive the runoff, the storage chamber comprising an inlet to receive runoff into the storage chamber and first and second discharge openings that each permit runoff to exit the storage chamber, the first discharge opening being the lowest elevation discharge opening in the storage chamber, the second discharge opening at a higher elevation than the first discharge opening, each discharge opening discharging to a respective flow path that flows runoff to the stormwater drain, the receiving tank comprising an inlet to receive runoff into the receiving tank, a discharge opening discharging to a flow path that flows runoff to the stormwater drain, and an overflow outlet fluidly connected to the storage chamber, the tank discharge opening at a lower elevation than the tank outlet opening;

(b) receiving a first volume of runoff through the storage chamber inlet and into the storage chamber when the storage chamber is initially empty;

(c) discharging the first volume of runoff received in the storage chamber through the first discharge opening while the water level in the storage chamber is below the second discharge opening and filtering the runoff discharged from the first discharge opening;

(d) receiving a second volume of runoff through the receiving tank inlet and into the receiving tank, the second volume of water sufficient to raise the water level in the receiving tank and discharging an overflow portion of the second volume of runoff through the receiving tank overflow outlet and into the storage chamber, the overflow portion sufficient to raise the water level in the storage chamber at or above the second discharge opening in the storage chamber; and

(e) discharging the runoff in the storage chamber simultaneously through the first and second discharge openings of the storage chamber while the water level in the storage chamber is at or above the second discharge opening while simultaneously discharging the runoff in the receiving tank through the receiving tank discharge opening.

24. The method of claim **23** wherein the receiving tank begins receiving the second volume of runoff after the storage tank begins discharging the first volume of runoff from the storage tank.

25. The method of claim **23** wherein the first volume of runoff is completely discharged from the storage chamber prior to the receiving tank receiving the second volume of runoff.

26. The method of claim **23** wherein the second discharge opening of the storage tank comprises a plurality of second discharge openings spaced apart in elevation from one another, and step (d) comprises the step of:

(f) discharging an overflow portion of the second volume of runoff into the storage chamber sufficient to raise the water level in the storage chamber at or above all the plurality of second discharge openings of the storage chamber.

27. The method of claim **23** wherein the storage chamber comprises a perforated chamber portion and a nonperforated chamber portion, and comprising the step of:

(f) discharging a portion of the overflow portion of the second volume of runoff received in the storage chamber through the perforated chamber portion of the storage chamber.

28. The method of claim **23** wherein the perforated chamber portion is initially empty and step (f) comprises the step of:

(g) raising the water level in the nonperforated chamber portion to a first water level; and

(h) flowing water into the empty perforated chamber portion only after the water level in the nonperforated chamber portion has reached the first water level.

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